

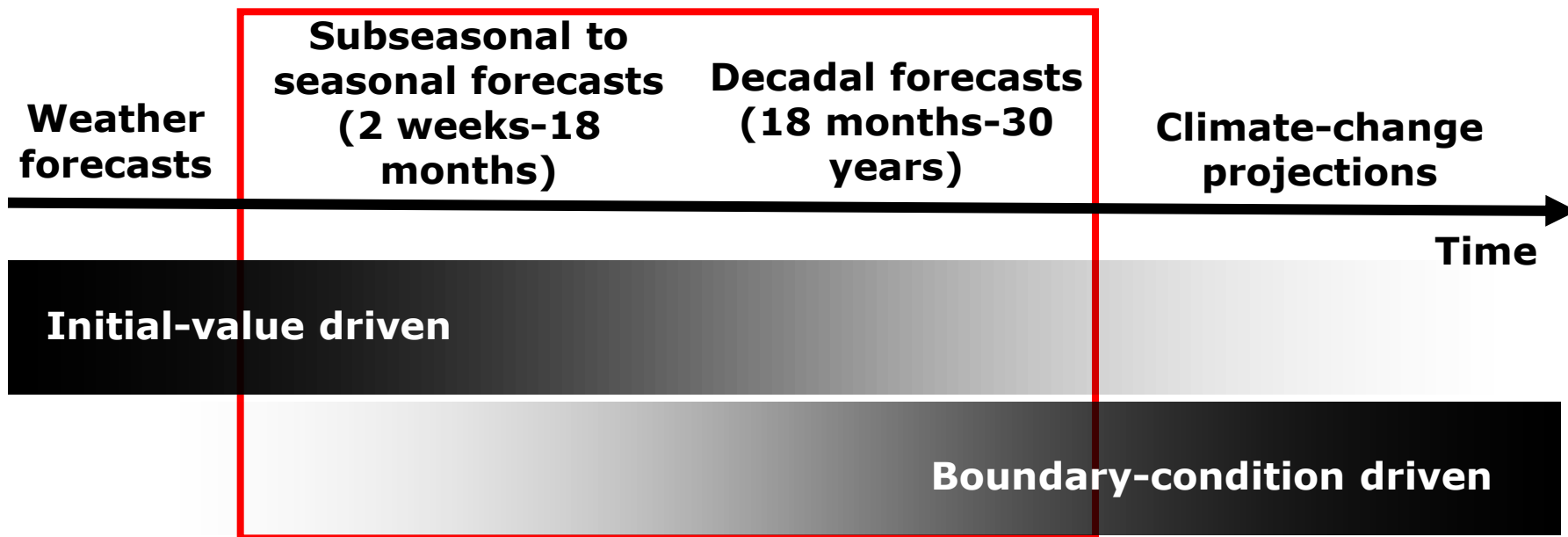
Weather, seasonal and decadal forecasts for the energy sector

F.J. Doblas-Reyes
ICREA, BSC and IC3, Barcelona, Spain



Climate prediction

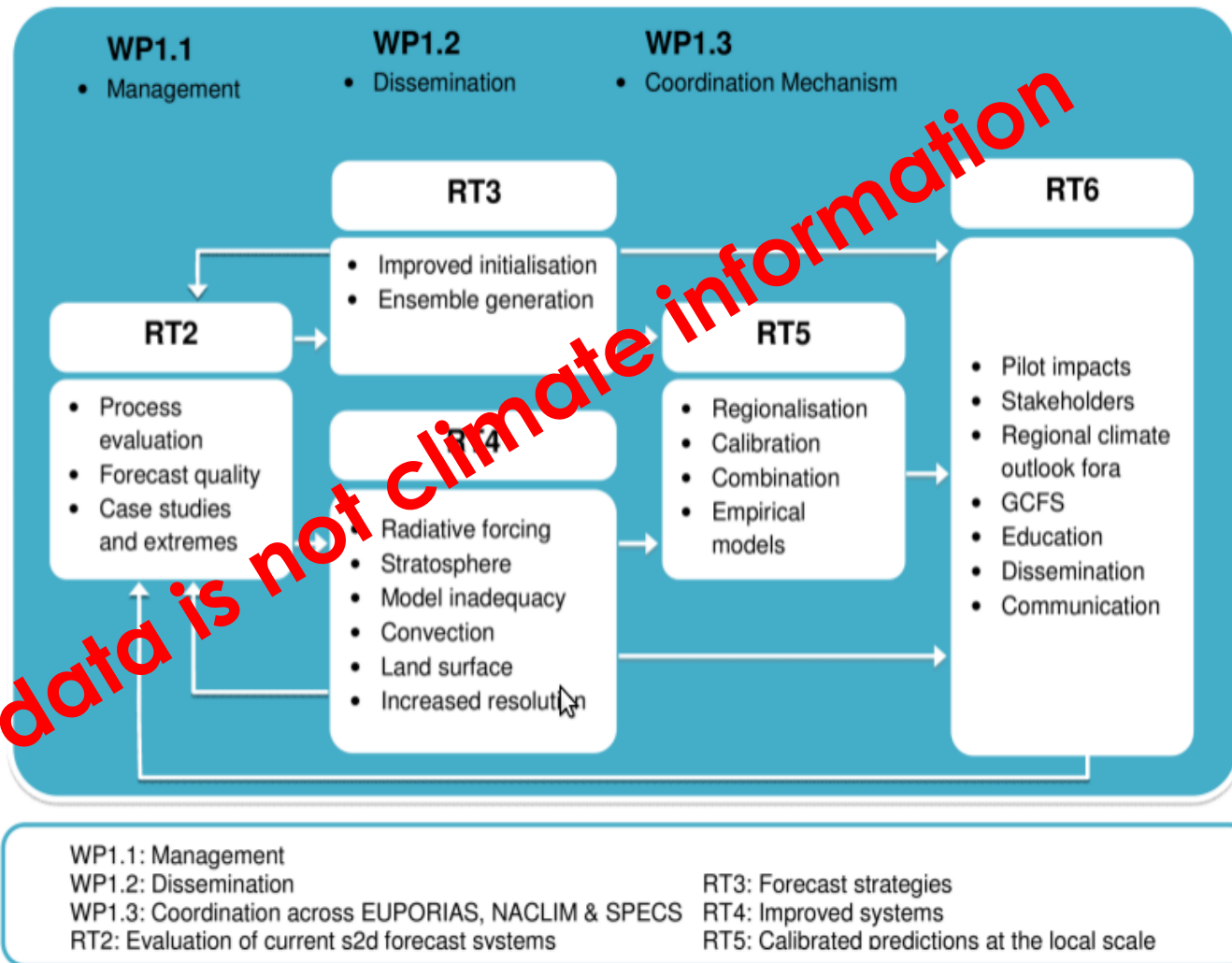
Progression from initial-value problems with weather forecasting at one end and multi-decadal to century projections as a forced boundary condition problem at the other, with climate prediction (**sub-seasonal, seasonal and decadal**) in the middle. Prediction involves initialization and systematic comparison with a **simultaneous** reference.



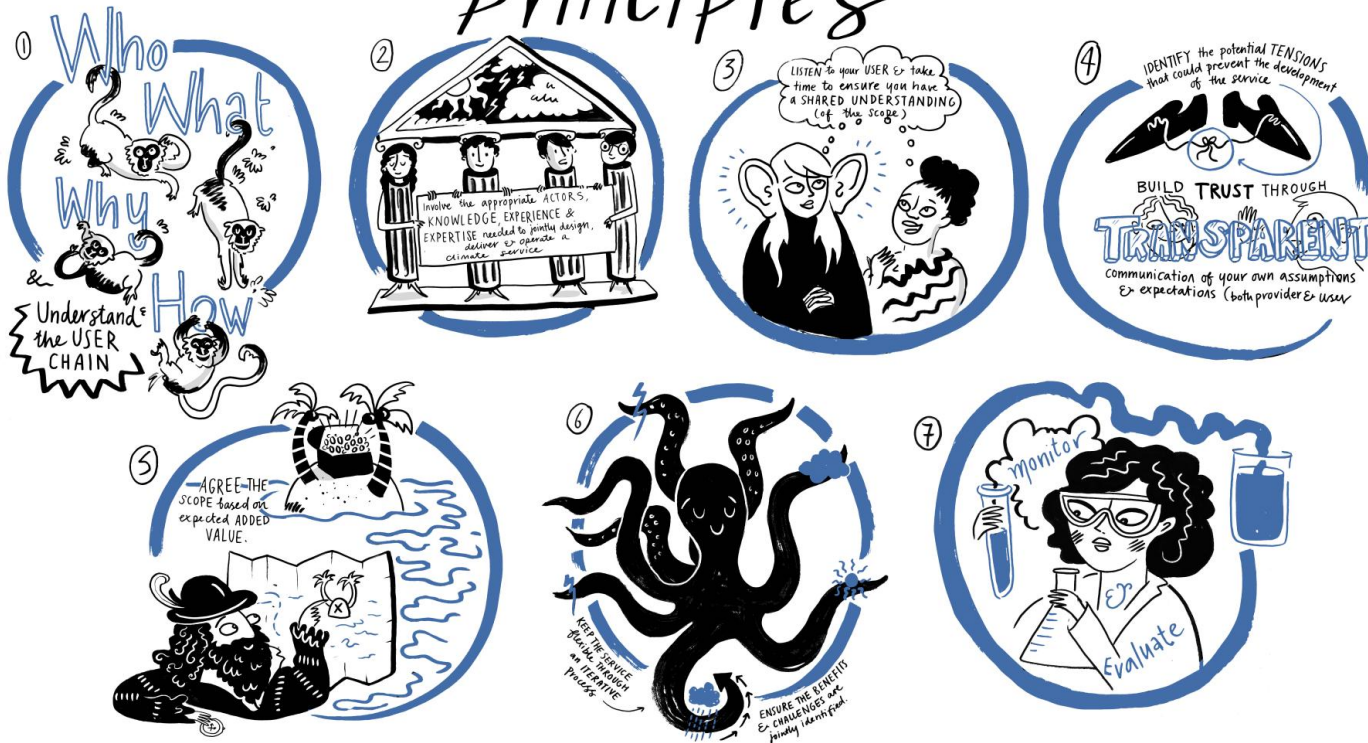
Adapted from Meehl et al. (2009)

Links to EUPORIAS/NACLIM (**ECOMS**), but also IS-ENES2, PREFACE, EUCLEIA, CLIPC, ...

Forecast System	Project Partners
CNRM-CM5	CNRM, CERFACS
EC-Earth	KNMI, SMHI, IC3, ENEA
IFS/NEMO	ECMWF, UOXF
IPSL-CM5	CNRS
MPI-ESM	MPG, UniHH
UM	UKMET



SUCCESSFUL CLIMATE SERVICE Principles



EUPORIAS

The energy sector requires:

- Forecasts for locations where the mean is large (wind speed above a threshold), and both variability (something to predict) and skill (something useful to say) are high
- Need energy generated over a period (month, season, etc), with uncertainty estimates, at the wind farm level
- Information for off-shore maintenance (~3 weeks lead time)
- Also consumption in other regions to balance network

Weather and climate forecasters have to deal with:

- Better understanding of the impact models, and the best way to adapt them to the useful climate information available
- Scarce observations
- Calibration (statistical properties mimic those of the data measured at the wind turbine height) and combination
- Downscaling, if necessary
- Documentation (use the IPCC calibrated language), demonstration of value, outreach

Pre-construction decisions:

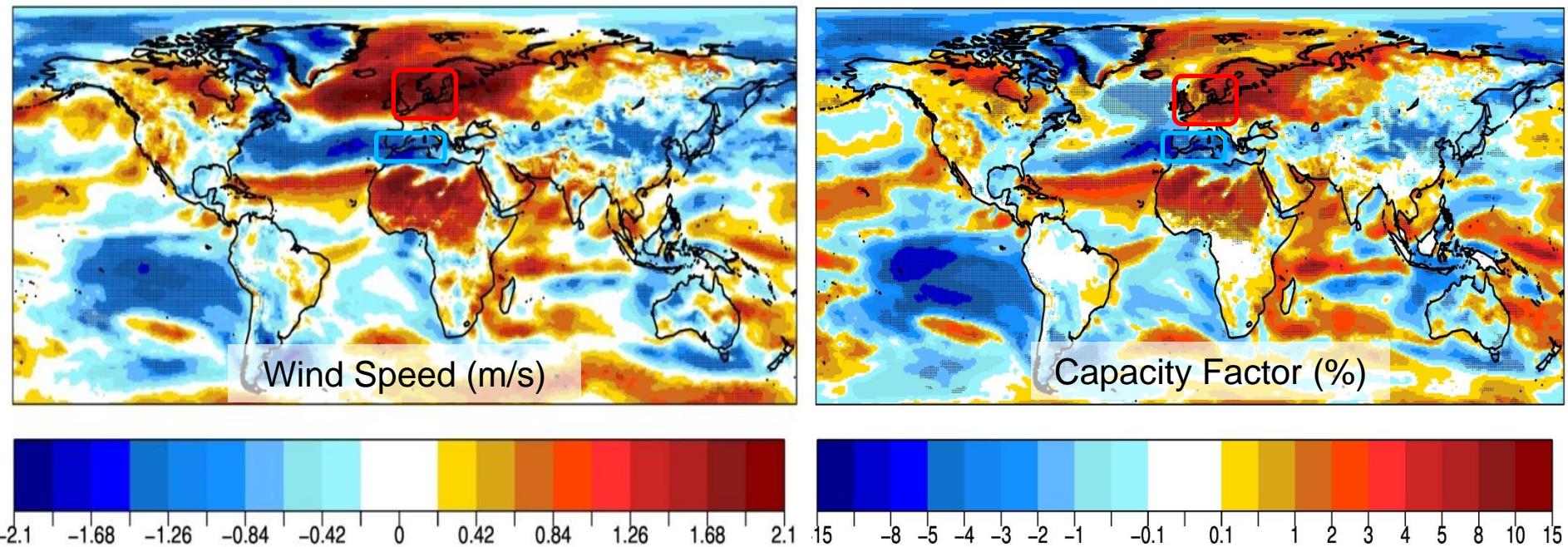
- **EDPR, wind farm planners:** Optimising site selection to account for the medium- to long-term
- **Iberdrola, wind farm investors:** Evaluate return on investments, maximise loan rates
- **National and EU policy makers:** Understand changes to energy mix, impact to energy security/stability

Post-construction decisions:

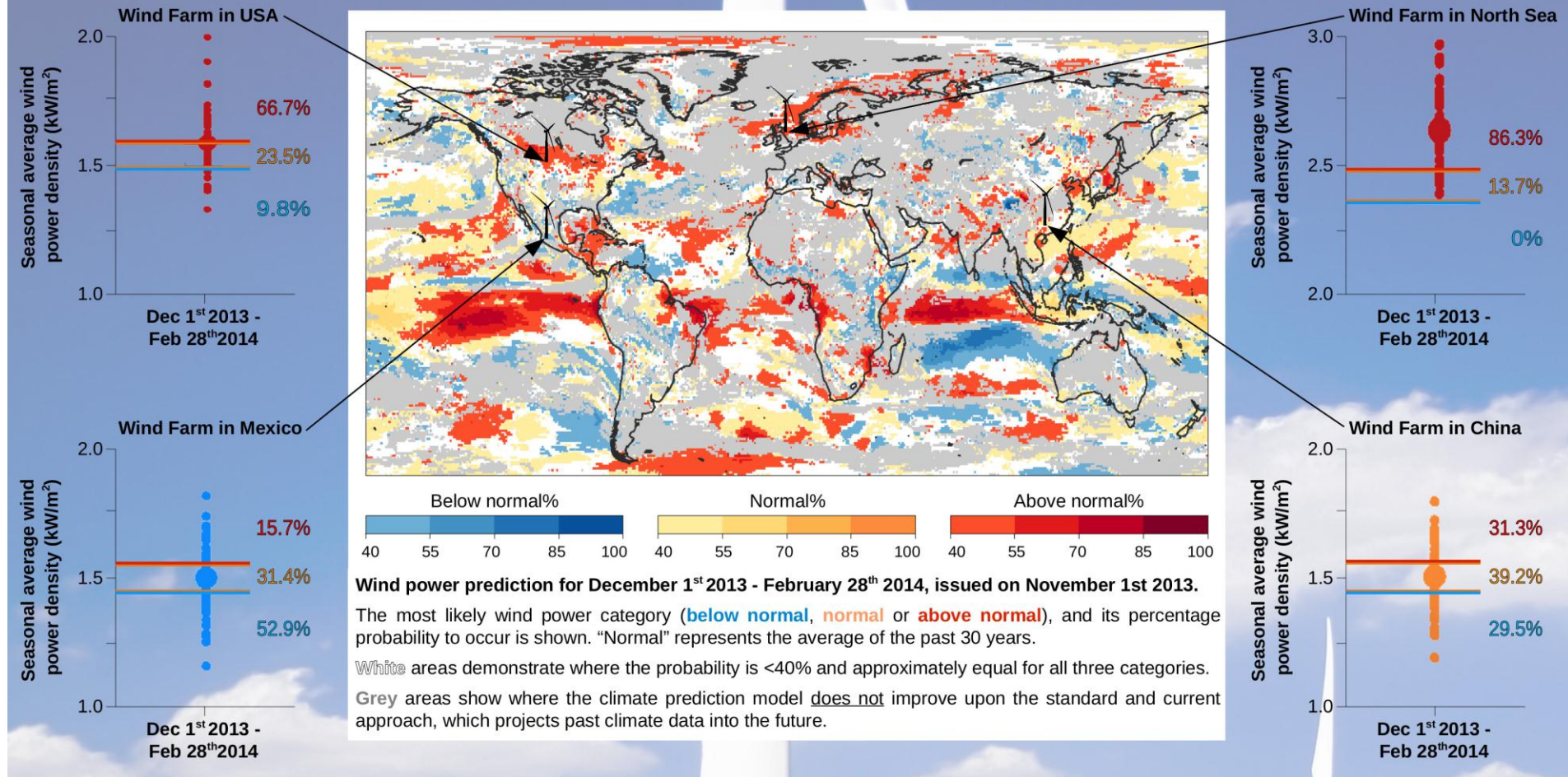
- **EDF, energy producers; RTE, grid operators:** Wind resource management for improved grid operations
- **Marexspectron, energy traders:** Wind power resource effects on financial markets
- **Alstom/GE, wind farm developers and operators:** Optimise planning for maintenance works
- **GE, wind farm investors:** Optimise return on investments, manage risk of low return periods

Difference in winter (DJF) standardised 10-metre wind speed (left) and capacity factor (right) for seasons with above normal and below normal North Atlantic Oscillation index.

Daily capacity factor (%) calculated from ERAInterim 10-metre wind speed and temperature data using an idealised power curve, a log scaling law to transform the wind to hub height wind, and a Rayleigh distribution to model diurnal variability.



Illustrative examples of seasonal wind power predictions



Advancing Renewable Energy with Climate Services (ARECS)

www.arecs.org, provide feedback, register your needs



HOME ABOUT ARECS PROJECTS NETWORK EVENTS NEWS JOIN US

Monthly to decadal probabilistic climate forecasts for safe and efficient energy management

Business Opportunities

Climate Variability and Risk

Wind Forecasts

Solar Forecasts

Decision Making Process

Publications

Newsletter

Glossary

MINIMISE UNCERTAINTY

Probabilistic climate forecasts predict the future variability and extremes in weather, to minimise uncertainty of renewable power supply and energy demand. Timescales of interest are from one month to decades.

MANAGE RISK

By understanding the expected variation of weather resources and its impact on the energy system, improved, proactive and anticipatory adaptation decisions can be made to better manage energy planning and operation risks.

OPTIMISE STRATEGIES

ARECS aims to stimulate the use of probabilistic climate forecasts to manage the future risk of renewable power supply and energy demand, by developing a full assessment of wind, solar and temperature predictability alongside tools to effectively analyse the forecasts.

How could wind power supply and energy demand vary next season?

It is currently unknown how wind, solar or temperature resources will vary from one season to the next. The ARECS newsletter aims to demonstrate how state-of-the-art climate forecasting could minimise the uncertainty of future resource variability, and guide decisions within the energy sector.

[Click here to view probabilistic forecast examples](#)

Could probabilistic forecasts been used to predict meteorological events in the past?

If your strategies were affected by a variability in climate conditions, please send us details of such events, so that we can assess how well our probabilistic forecasts could have predicted them. Information should include the reference month, season or year, the geographical area, and the observed meteorological conditions:

[Click here to send information.](#)

Website



Issue 2: released February 2014

[View this email in your browser](#)

Wind Forecast for last spring 2013

ARECS
Advancing Renewable Energy with Climate Services

Seasonal Forecasts for Wind Energy

How will wind power vary next season, and how could this affect your:

- Investment Cash Flow - Energy Trading - Insurance Derivatives -
- Operation & Maintenance Schedule - Energy Balance -

It is currently unknown how wind resources will vary from one season to the next, and the effect this could have on important planning and operational questions like those above.

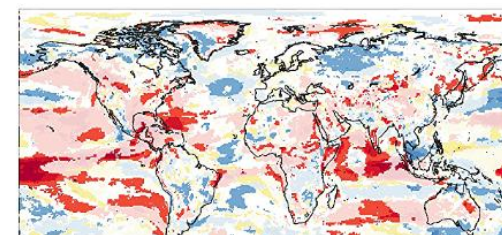
The aim is to demonstrate how state-of-the-art climate forecasting could minimise the uncertainty of seasonal wind variability, and guide decisions within the wind energy sector.

This quarterly newsletter provides probabilistic forecasts from the same up to the next season. In the future, wind forecasts could be issued in real time via a climate service, for a given season and at a relevant spatial scales.

Newsletter

Probabilistic Spring 2013 Forecast of the Most Likely Wind Speed Category (above normal, normal or below normal)

This spring season forecast demonstrates wind information that could have been made available on February 1st 2013 for months March - May (inclusive) 2013.



Data represented:

Observed 10m Wind Resource Anomalies (m/s): based on reanalysis data (ERA-Interim), not direct observations.

Forecast 10m Wind Resource Anomalies (m/s): based on post-processed ECMWF - S4 forecast system data.

Coloured areas: forecast - observation.

Transparent areas: forecast = observation.

Areas where the

SPECS develops decision management tools for stakeholders:

<http://giotto.casaccia.enea.it/specs-solar/>

ECMWF System 4 Seasonal Forecasts: Solar Radiation and Temperature

Choose a forecast variable:

Surface Solar Radiation (JJA) ▲

2-m Temperature (JJA)

2-m Temperature (DJF)

Surface Solar Radiation (JJA)

Surface Solar Radiation (DJF)

[DET] Spearman Correlation Coefficient ▼

Show significant points:

No ▼

Years

1,984 2,007

1,984 1,987 1,990 1,993 1,996 1,999 2,002 2,005 2,007

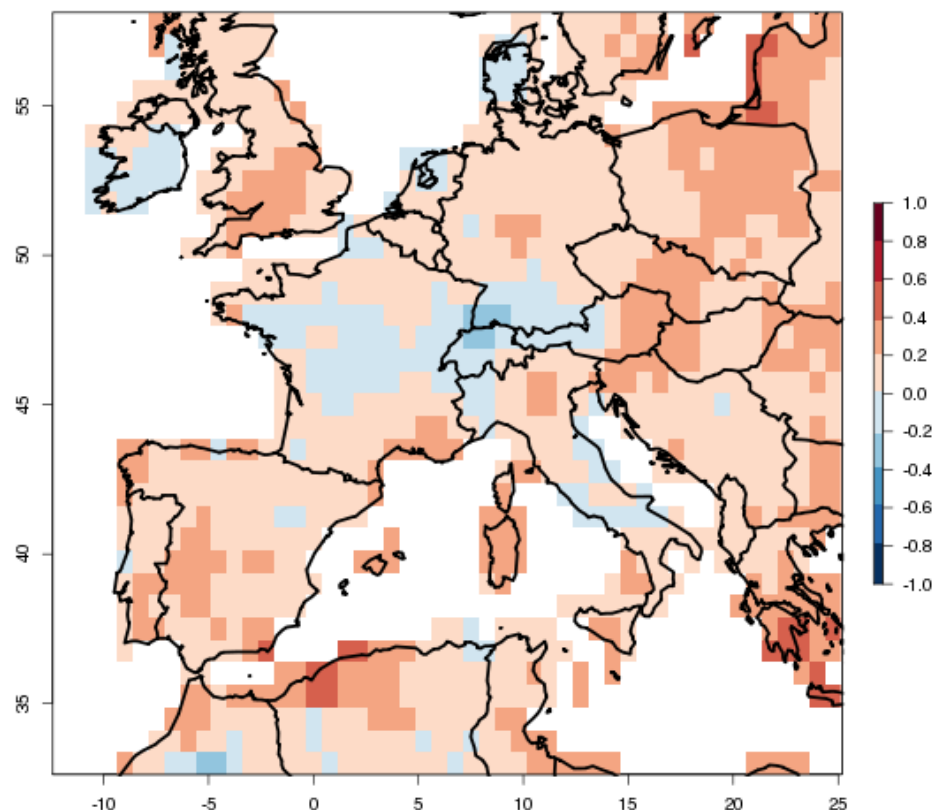
Lead Time (months)

1 3

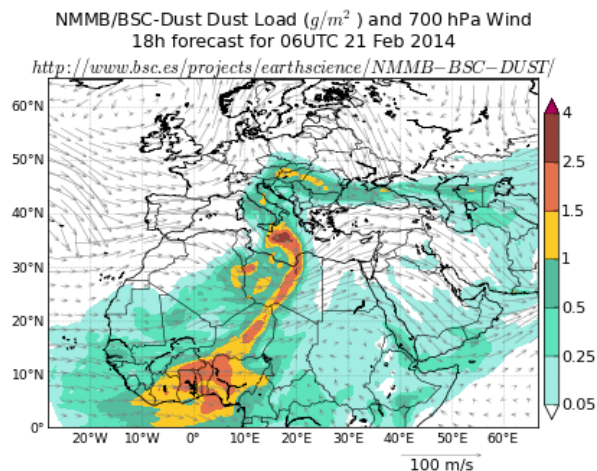
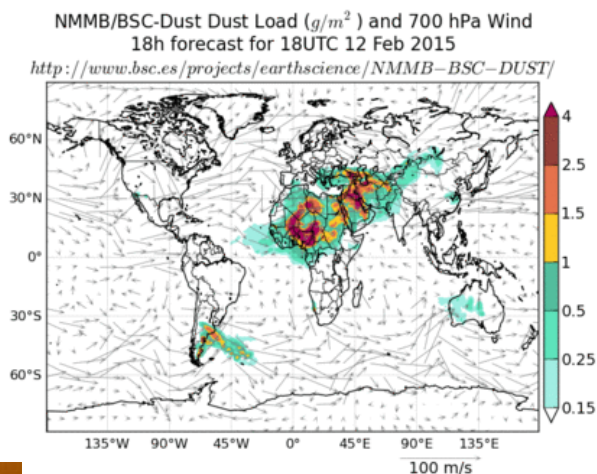
☐ Remove trend from data

☐ Interpolation

SRB data has been downloaded from [here](#)



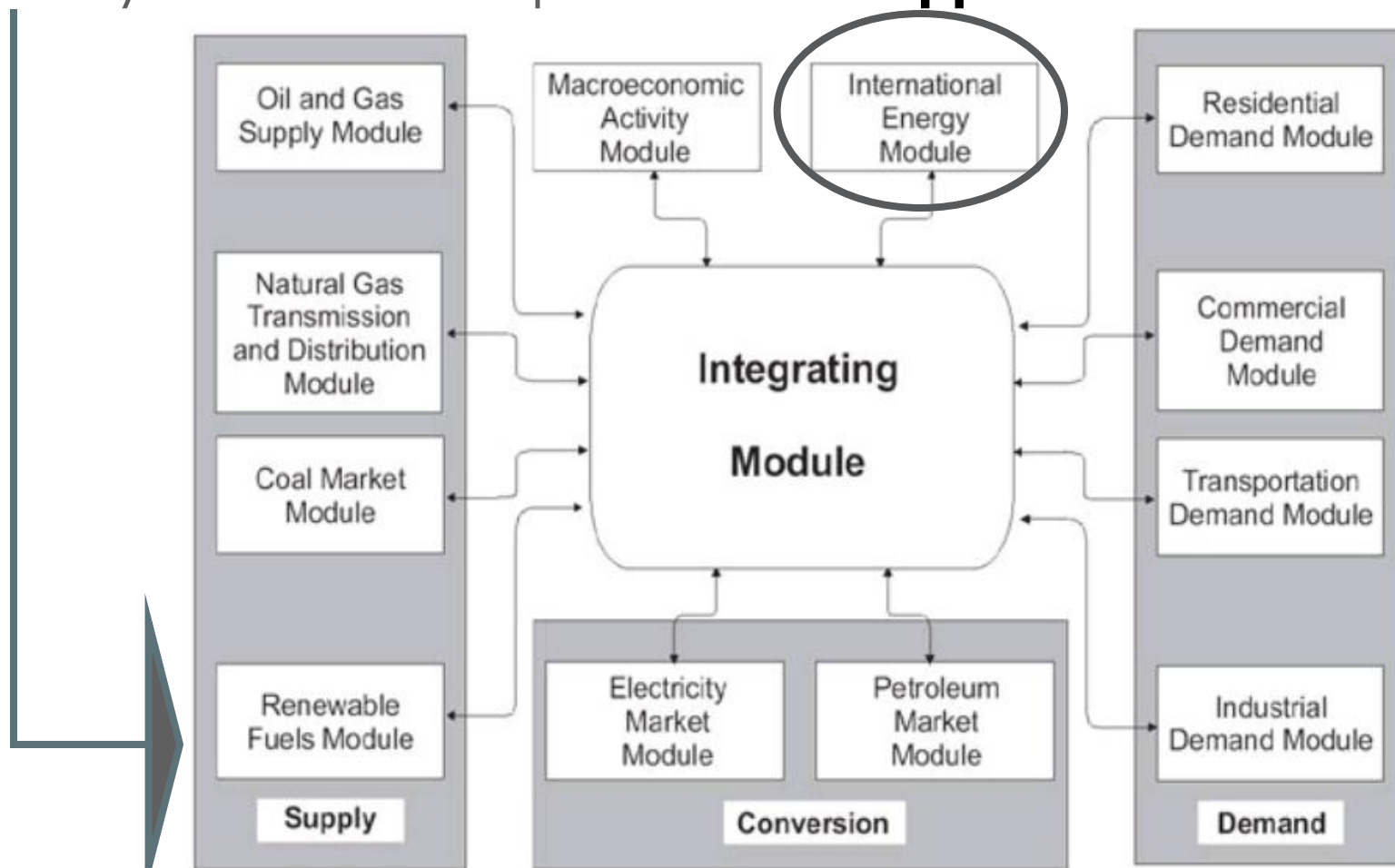
BSC and AEMET manage the WMO SDS-WAS NAMEE Regional Center (<http://sds-was.aemet.es>) and the Barcelona Dust Forecast Center (<http://dust.aemet.es>). This effort contributes to solar energy management preventing energy loss and helping with the location of future plants.



RE is just part of the story

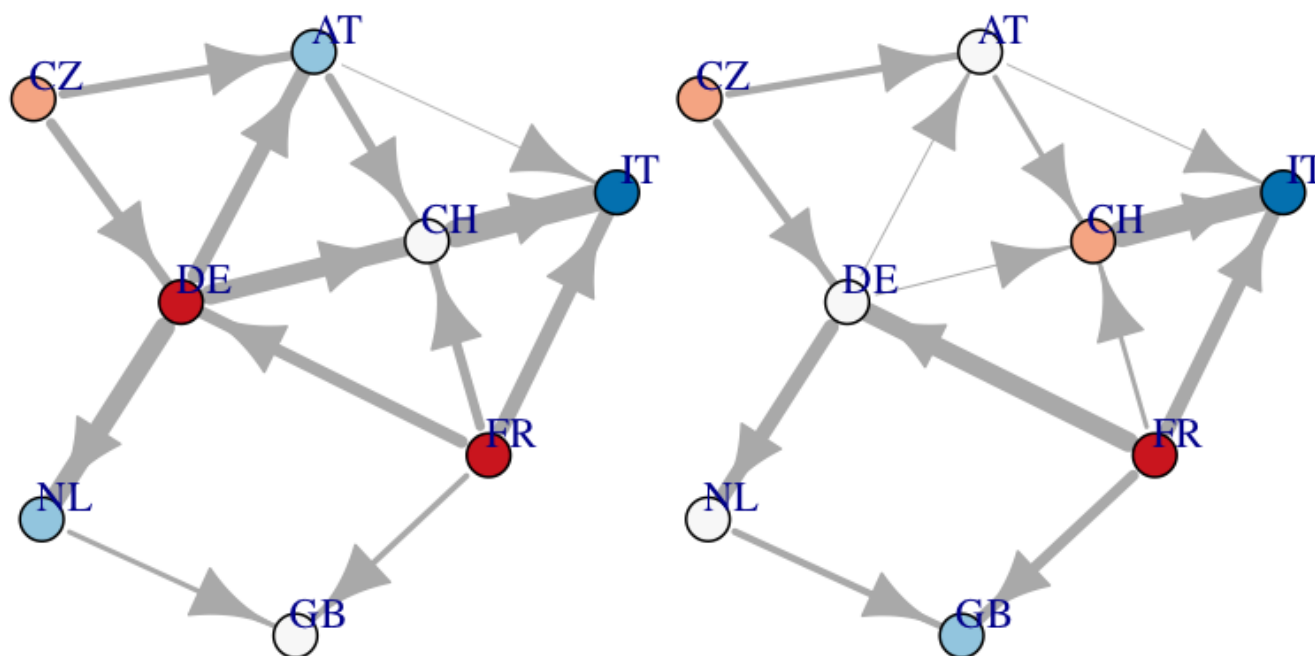
Example of a national energy modelling system.

We only addressed this part. **Holistic approaches are needed.**



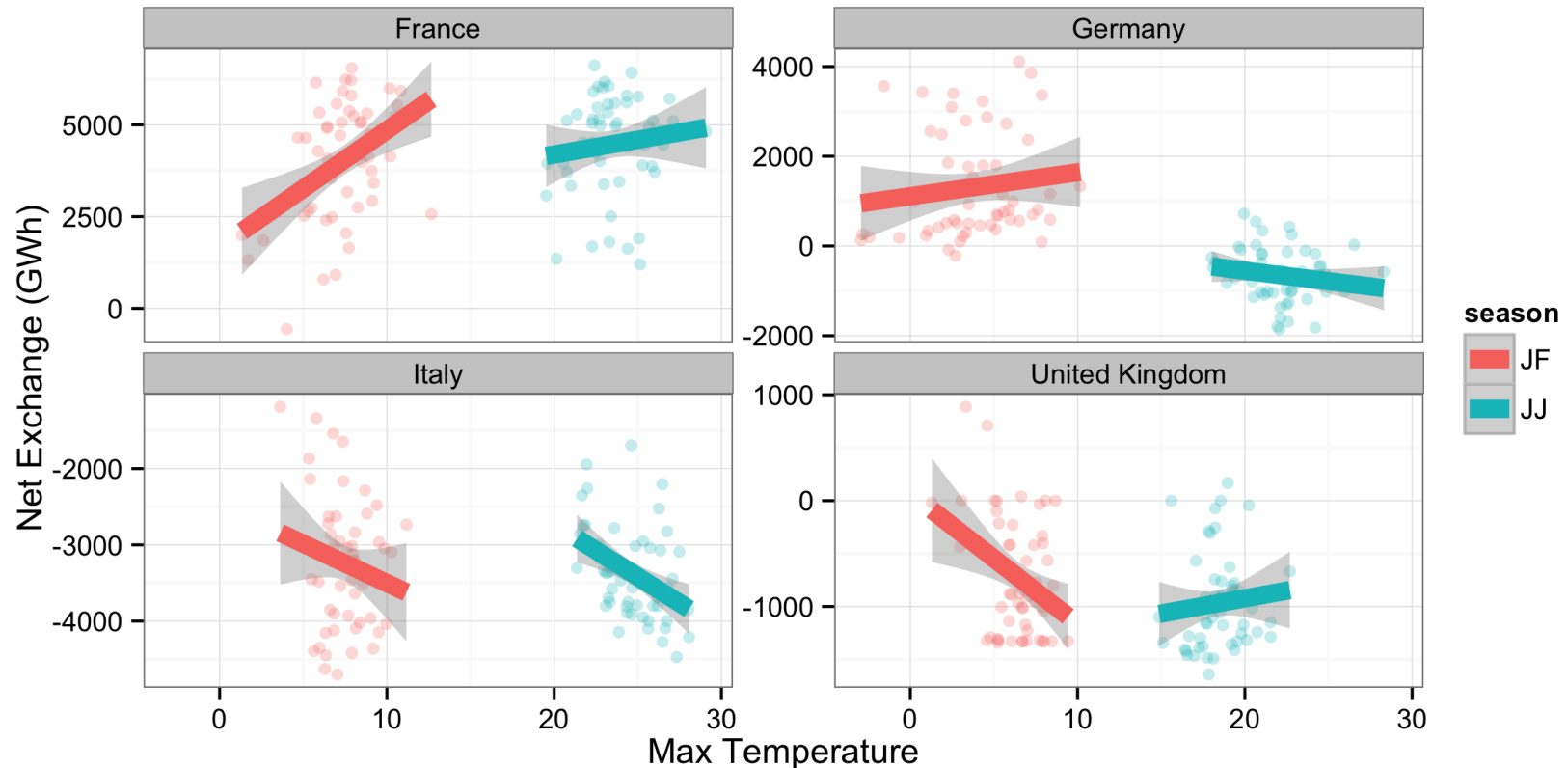
The role of energy export

European electricity flows for Jan-Feb (left) and June-July (right). Red nodes are the main exporters and blue the main importers. For clarity only the eight countries with the highest exchange are shown. Data from ENTSO-E (2003-2014).



The role of energy export

Weather and climate affect exchanges via electricity demand (heating or cooling, from the customer point of view) and RE production.



Grand Challenge on Regional Climate Information: What gaps in our scientific understanding and information, if addressed, would maximise the value content of regional climate information?

Steering group: Clare Goodess (WGRC), Francisco Doblas-Reyes (WGSIP), Lisa Goddard (CLIVAR), Bruce Hewitson (WGRC), Jan Polcher (GEWEX & WGRC), supported by Roberta Boscolo (WCRP)

Initial case study for the city of Maputo (Mozambique)

WCRP Organization

